**Learning Activity Three:**

**Properties of Light: Shadows**

**Description of the Activity:**

This activity is the third lesson in a five lesson unit on light and sound as forms of energy for a third grade science class. This lesson explores the properties of light by challenging students to experiment and investigate the content of shadows. The lesson will use a type of inquiry method of teaching science called the five “E” learning model of inquiry teaching. Technology will be integrated into the lesson in order to enhance the learning and exploration of the concept of shadows. Technology integrated into this lesson includes an educational website used during student exploration time to help students gain insights into shadows cast by objects that are too large to observe in the classroom, a classroom digital projector to create shadows and show a video on shadows, flashlights for experimentation, and the use of a classroom science blog for reflection and review.

During the lesson students will be creating shadows using various materials and devices. They will experiment with creating and observing shadows through the inquiry method of science. Students will explore how shadows are made by creating them in and outside of the classroom. By observing the shape of shadows they make, students will learn that shadows are created when light is blocked by an object. Students will experiment with the angle and direction of the light sources in order to draw conclusions about the properties and characteristics of shadows.

For this lesson, students will be working in groups of 3 to 4 students each. Students will use classroom computers and the lesson will take place both inside the classroom and outside on the school playground. Students will have access to computers with Internet, flashlights, and a digital projector. Students will also need to be able to type their reflection question into our classroom science blog either on computers at home or in the classroom.

For this lesson, students will already need to know how to use basic functions of a computer, such as, turning it on and how to access the internet. Students will need to understand the concepts of being online and working on educational websites. Students will need to use program features such as using a mouse over text, toolbars, basic program menus, and basic typing. Students will also need to already know how to navigate the internet at a basic level with teacher guidance and support. For using the classroom science blog, students will already need to know how to access and submit information to the science blog. This will be introduced earlier in the year during a class lesson on using the blog. This will not be the students first time accessing the science blog. Students will also need basic keyboarding skills for typing their reflections into the blog.

**Learning Objective:**

Learner Population: This lesson is intended for 3rd to 4th grade students. It will take place over a one hour science class session.

I will be teaching this lesson to a classroom of multi-aged mixed ability students made up of third and fourth graders. I will teach a population of 43 students this lesson. However, I will work with 2 groups of about 20 students at one time. I will teach one group of students this lesson for one class sessions, then the other group of 20 students the lesson on separate days.

Standards and benchmarks addressed: For this lesson I am addressing numerous State of Michigan Grade Level Content Expectations for third grade science. I am also addressing several National Technology Standards for K-12 students.

Goals and Objectives

At the end of this activity students will…

* Design an experiment
* Make observations about the size and shape of shadows
* Create a model for crating shadows using a light source
* Reason about the size and position of a shadow based on the angle and position of the light source
* Conclude that shadows are created when light is blocked by an object
* Define a shadow as the darkness that shows when light is blocked, and that a shadow takes the outside shape of the object that is blocking the light

**Technology Integration:**

The technology integrated into this lesson enhances the learning process for students in many ways. The technology used to create light sources is critical for creating shadows. Students will be able to use flashlights and a digital projector to create a light source for creating shadows. Students will be able to manipulate the light sources they use to experiment with the angles, sizes, and shapes of the shadows they create. With the light sources being used in the classroom students will be able to model how the sun creates shadows naturally. With the use of technology to create light sources students will be able to learn that shadows are shorter when a light source is directly overhead an object. This will model how shadows are shorter at noon because the sun is overhead. The light sources will also be able to model the natural behavior of the sun casting longer or shorter shadows based on the angles of the light being cast. Without the technology used to create the light sources, students would not be able to model these properties of shadows in the classroom. The use of the internet website activity, found at the website: [www.bbc.co.uk/schools/scienceclips/ages/7\_8/light\_shadows\_fs.shtml](http://www.bbc.co.uk/schools/scienceclips/ages/7_8/light_shadows_fs.shtml), challenges students to model shadows being cast on objects that are too large to experiment with in a classroom setting. The program also allows students to model the sun being in different positions in the sky, which allows students to explore its effects on shadows being created. This website tool allows students to explore how shadows are made on objects larger than objects being explored with in the classroom.

The technology being integrated into this lesson fits nicely within the engagement, exploration, and extend sections of the five “E” learning model of inquiry teaching being used in this lesson. The only change in the instructional process for me is gathering the materials needed and guiding students during their use of the internet during their exploration.

**Connection to Standards:**

* State of Michigan Standards and Benchmarks 3rd Grade Science

***K-7 Standard S.IP:*** *Develop an understanding that scientific inquiry and reasoning involves observing, questioning, investigating, recording, and developing solutions to problems.*

**S.IP.E.1 Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.**

***K-7 Standard S.IA:*** *Develop an understanding that scientific inquiry and investigations require analysis and communication of findings, using appropriate technology.*

**S.IA.E.1 Inquiry includes an analysis and presentation of findings**

**that lead to future questions, research, and investigations. S.IA.03.12** Share ideas about science through purposeful conversation incollaborative groups.

**Energy**

***K-7 Standard P.EN:*** *Develop an understanding that there are many forms of energy (such as heat, light, sound, and electrical) and that energy is transferable by convection, conduction, or*

*radiation. Understand energy can be in motion, called kinetic; or it can be stored, called potential. Develop an understanding that as temperature increases, more energy is added to a system. Understand nuclear reactions in the sun produce light and heat for the Earth.*

**P.EN.E.1 Forms of Energy- Heat, electricity, light, and sound are forms of energy.**

**P.EN.03.11** Identify light and sound as forms of energy.

**P.EN.E.2 Light Properties- Light travels in a straight path. Shadows result from light not being able to pass through an object. When light travels at an angle from one substance to**

**another (air and water), it changes direction.**

**P.EN.03.21** Demonstrate that light travels in a straight path and that shadows are made by placing an object in a path of light.

**B: National Educational Technology Standards for K-12 Students**

1. Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.

c. Use models and simulations to explore complex systems and issues

2. Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital

environments and media.

b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats

3. Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information.

a. Plan strategies to guide inquiry

b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media

c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks

d. Process data and report results

4. Critical Thinking, Problem Solving, and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

**Student Prior Knowledge:**

Prior to this lesson and at the beginning of this unit, students will be pre-assessed on light and sound as forms of energy. For this particular lesson, student prior knowledge will be assessed through the use of a KWL chart at the beginning of this lesson. Each individual student will be given a piece of paper with a KWL chart on it. Students will write what they know about shadows, and what they want to know about shadows. At the conclusion of the lesson, students will write what they learned about shadows. Students will be prepared to meet the objectives and benchmarks of this lesson after the successful completion of the first two learning activities in this unit. Students will have knowledge about light as a form of energy. They will already know that light travels in a straight line.

**Content Knowledge:** Light and Shadows

For this lesson, teachers will need knowledge on light as a form of energy. Teacher content knowledge for this lesson includes knowledge about the proprieties of shadows. Teachers will need to know that shadows are cast on a surface when an opaque object intercepts rays from a light source. Shadows are an area of darkness from light being blocked by an object. Teachers should also have content knowledge of the sun as related to shadows. They should know that the sun produces light rays which strike the earth in nearly all directions. As the earth rotates, the angle of the light rays change, producing shadows of different lengths and directions depending on the time of the day.

I personally possess all content knowledge necessary to lead this lesson with students. My content knowledge has been obtained through study through science units of light and sound in college, studying benchmarks and content expectations, reading science text books on light and shadows, and through experiences teaching shadow content in the past to students at this age.

**Pedagogical Knowledge:** Inquiry method to teaching science

This lesson will use an adapted form of the inquiry method for teaching science following a “Five E” model of inquiry teaching. Students will be guided to explore and construct new learning through a guided exploration. The method of inquiry for this lesson will follow this format:

Engage: The engage portion of the activity will get students excited and engaged in the study of shadows. For this engage activity, the class will complete their KWL chart on shadows to assess student prior knowledge. The class will then go outside to the school playground to look for shadows. The teacher will guide the class during this exploration and foster questions and ideas about how the shadows are being formed. After a short time outside the class will come back inside to being their exploration and investigations into shadows.

Exploration: Students will be challenged with an exploration question that will guide their experimentations. The exploration question will guide students to create shadows using flashlights and the digital projector. Students will be prompted with the question, “How can you create shadows in the classroom using the materials you have? How can you change the sizes or shapes of the shadows you create?” For this exploration, students will work in groups using the flashlights and projector, paper and pencils to create shadows and to manipulate the light sources they use to change the shadows they produce. As groups design and complete their explorations, the teacher will invite two to three groups at a time to investigate the activity on the website: [www.bbc.co.uk/schools/scienceclips/ages/7\_8/light\_shadows\_fs.shtml](http://www.bbc.co.uk/schools/scienceclips/ages/7_8/light_shadows_fs.shtml). The activity on the website flows well with the exploration with the light sources. However, the website activity allows for students to work with models of objects and light sources that they cannot access physically in the classroom.

Explain: Students will begin the explanation portion of the lesson by sharing their findings in the exploration section. Each group will present their answers and ideas to the exploration question by presenting their written reports and by explanations to the class as a class discussion. The teacher will then guide the class through an explanation of the content of shadows. The teacher will lead students through the definition of shadows and explain how the angle of the light source can manipulate shadows. The teacher will also show a brief video on brainpop.com to summarize their work and understanding of light and shadows. The video on brainpop.com is titled, “light” and runs for 3 minutes. The video will be projected using the digital projector.

Extend and Apply: Students will extend their learning about shadows through reflection. Students will reflect about their learning using the classroom science blog. Each student will respond to the classroom science blog reflection question at home as part of their homework. Students unable to respond at home will have time to do so in the classroom. The reflection questions will be, “Where else have you seen shadows outside of school? How do shadows change during the day?”

Evaluate: Student learning will be evaluated through the completion of their KWL chart, the completion of their written explanation to the explore question, and their completion of their personal reflections submitted to the classroom science blog.

**Technology Knowledge:** Computers with Internet, BBC website, “BrainPop” website with “light” video, Classroom Science Blog, digital projector, flashlights.

Teachers also need knowledge of how to set up and run a classroom blog. The classroom blog used for my classroom blog is found on the website: <http://edublogs.org>. Teachers will also need to be able to troubleshoot basic computer and internet functions during the lesson. The basic troubleshooting teachers will do include; turning on and off computers, managing website troubles, and basic typing support.

Teachers will also need to know how to run and operate a digital projector. Teachers will need to know how to hook up and project images onto a screen or white board. Teachers should read directions on the projector they have to gain this knowledge.

I personally have all technology knowledge needed for success in this lesson. I gained this knowledge through my work on my master’s degree program and my experiences teaching with blogs and by using digital projectors.

**TPACK Analysis:**

Starting with the content of shadows, an inquiry based approach to teaching is an effective and acceptable method for this content. My undergraduate training at the University of Michigan Dearborn taught me the five “E” teaching model of inquiry based learning. I actually taught a shadows lesson using this method to a younger group of students during my time as an undergraduate student at U of M-Dearborn. These experiences taught me that an inquiry based approach is effective when teaching shadows. The technologies selected to integrate into this lesson are both effective in enhancing student learning of the content (shadows) and fit in well with the inquiry method of teaching. The use of the website with the shadows activity fits well into the exploration section of the lesson, and enhances student exploration of shadows to work with models of objects they would otherwise be unable to work with in the classroom. The website is a good tool because it allows students to explore with items that would be too large to experiment with in the classroom setting. The website also allows for students to manipulate light sources such as the sun to see the effects to sources has on shadows. Again these experiments could not be done in the classroom setting in one class period as required of this activity. The video also delivers content on shadows that would be difficult to demonstrate in the classroom. One portion of the video demonstrates a model of the sun which the students would otherwise unable to see. The classroom blog fits extremely well into the extend section of this lesson as it fosters reflection for students in a manner which allows students to feel safe. The video and website are engaging to students as well as effective ways to deliver the content they are learning about, and can be successfully integrated into the inquiry method of science teaching selected for this activity.

**Assessment Plan:**

Students will be assed with the completion of three products in this lesson. Students will be assed with the completion of their KWL chart. At the beginning of the lesson students will write what they know, and what they want to know about shadows. At the end, students will write what they have learned about shadows. If students have correctly completed the chart, and have written factual knowledge in the “what they have learned” section, then they have completed this portion of the assessment. Secondly, students will be assessed based on the written explanation of the exploration question completed during group work time. If student’s correctly answer and explain their explorations and explore question with facts and support, then they have successfully completed this portion of the assessment. Finally, students will be assessed on their completion of the classroom science blog. If students respond to the reflection question “Where else have you seen shadows outside of school? How do shadows change during the day?” and present support and reasons for their thinking, then they have completed this portion of the assessment.

A final performance task that students will do is to come to the projector one at a time to interact one on one with the teacher. Students will be given a 3X5 card and will need to create a shadow with it by block the light from the projector. Students will need to demonstrate that they know how to create a shadow and that they can change the proprieties of the shadow they have created by moving the light source and the card. This performance task will be performed quickly with each student and the teacher. The teacher will check off if each student demonstrates knowledge of shadows based on their performance task and can take notes as needed. This performance task can be completed after the activity has been completed during any part of the school day.

**KWL Chart: Shadows**

Directions: Fill in the KWL chart to explain what you already know about shadows, what you want to know about shadows, and then what you have learned about shadows.

|  |  |  |
| --- | --- | --- |
| Know (Shadows) | Want to Know (Shadows) | Learned (Shadows) |
|  |  |  |

Exploration Report: Shadows

Directions: Fill in data and answer the questions as you explore shadows. Answer the exploration questions with complete sentences. Write the name of the light source used, and the material you used to create the shadow.

Light Sources: Projector, Sunlight, classroom light, flashlight.

1. Light source: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Material used:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What happened: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How can you change the size and shape of the shadow?

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1. Light source: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Material used:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What happened: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How can you change the size and shape of the shadow?

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1. Light source: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Material used:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What happened: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How can you change the size and shape of the shadow?

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Material used:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What happened: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How can you change the size and shape of the shadow?

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1. Light source: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Material used:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What happened: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How can you change the size and shape of the shadow?

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**Exploration Questions:**

How can you create shadows in the classroom using the materials you have?

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How can you change the sizes or shapes of the shadows you create?

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